Raritan Piedmont Wildlife Habitat Partnership

Grassland Conservation Plan

Effective Stewardship of Public and Private Lands and Targeted Preservation of Critical Habitat

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Cover Photos, clockwise from upper Left Corner: *Eastern Meadowlark – NJAS Stock Photo; Grass Seed Drill – US Fish & Wildlife Service; Native Warm Season Grasses and Wildflowers – Natural Resources Conservation Service; Native Warm Season Grass Seeding Negri-Nepote Native Grassland Preserve, Franklin Township – Troy Ettel; Grasshopper Sparrow – Art Morris; Skeet-Shoot Field Duke Farms – Troy Ettel.*

Acknowledgements

The Raritan Piedmont Wildlife Habitat Partnership represents a distinct coalition of stakeholders with a mission to insure the prompt and effective implementation of New Jersey's State Wildlife Action Plan (SWAP) through promotion of strategic, science-based habitat preservation, restoration and enhancement in a portion of the Raritan River Watershed in north central New Jersey.

The Partnership consists of several public agencies, including representatives of the NJ Endangered and Non-game Species Program, Department of Environmental Protection; Somerset County, and Hillsborough Township. Private partners include the NJ Audubon Society, the Delaware & Raritan Greenway Land Trust, the NJ Conservation Foundation, the Conserve Wildlife Foundation, the Sourlands Planning Council, The Nature Conservancy in New Jersey, the New Jersey Field Office of the Trust for Public Land, the Stony Brook Millstone Watershed Association, the Upper Raritan Watershed Association, and the Duke Farms Foundation. Future participation and representation will include other municipalities in the region as well as other non-profit conservation organizations active in this area.

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Wade Wonder's pioneering status surveys of New Jersey's grassland birds provided inspiration for this initiative and helped set a benchmark for success.

The Raritan Piedmont Wildlife Habitat Plan: A Cooperative Model for Implementation of the New Jersey Wildlife Action Plan

The Raritan Piedmont Wildlife Habitat Partnership represents a distinct coalition of stakeholders with a mission to insure the prompt and effective implementation of New Jersey's Wildlife Action Plan (SWAP) through promotion of strategic, science-based habitat preservation, restoration and enhancement. If the SWAP is meant to offer a blueprint to unite all conservation initiatives, then the Partnership demonstrates an effective means to implement this strategy through cooperation amongst local governments and nongovernmental organizations.

The geographic extent of the Partnership encompasses a unique region in the Central Piedmont Plains of New Jersey rich in both its broad diversity of wildlife and natural habitat types. Sprawling corporate campuses, large industrial complexes, and rapidly expanding suburban and exurban communities share the Central Piedmont Plains with picturesque horse farms and some of the State's largest remaining agricultural landscapes. These scenic vistas as well as the region's position between two of the nation's largest metropolitan areas (Philadelphia and New York City), combine to exert nearly unparalleled pressure from urban sprawl and development upon much of the Central Piedmont Landscape. Despite this, the Central Piedmont Plains continue to offer refuge to populations of threatened and endangered wildlife of regional and State significance.

Upland and riparian woodlands that contain important breeding and stopover habitat for migratory birds and other forest wildlife can be found in the Central Piedmont Plains. The most important forested block in the region is the Sourland Mountains which encompasses over 7000 hectares. However, it is the relatively intact, large agricultural landscapes within the Central Piedmont Plains that clearly rank as the region's most significant habitat type. The Partnership will initially focus on delivery of the SWAP goals by concentrating on preservation and restoration of grassland habitat within a discrete subsection of the Central Piedmont Plains that contains three large agricultural landscapes in close proximity to each other. This region was selected because of: 1) the existence of two Natural Heritage Priority Macrosites (NHPM) designated due to their significance for rare grassland wildlife, 2) the existence of a large State-owned property (over 1200 hectares), historically significant for grassland birds, that offers the best opportunity to manage for grassland wildlife on public land in New Jersey, and 3) the large agricultural landscapes within the project area that once contained the most significant grasslands in New Jersey – the only region where all of the State's threatened and endangered grassland birds have been documented as nesting. These sites could be cooperatively managed to maintain populations of rare grassland birds in the region that would significantly contribute to State and regional goals for preservation of the species.

The Partnership followed a discrete, science-based approach to set numerical population and habitat goals for each target species based upon national and regional conservation models supported by local data. Using these goals, the Partnership then conducted a GIS

analysis to identify the most critical clusters of habitat and identified the owners of individual parcels within the key clusters.

Delivery of conservation goals as set out by the Partnership will offer a very unique opportunity to demonstrate critical attributes that resonate within all State Wildlife Action Plans throughout the country. These include developing biologically-based strategies for: 1) applying appropriate management of critical habitats to public land, 2) initiating conservation projects on private lands by engaging private landowners through collaborative conservation agreements, stewardship training workshops, loans, and other proactive outreach, and 3) targeted acquisition of parcels of critical habitat as determined by the RPWHP Grassland Conservation Plan.

The project's overall success will be measured both in hectares protected (through acquisition or easement), actual number and percentage of landowners contacted within the focal area, acreage restored and managed to appropriate habitat, and, most importantly, by achievement of the population goals established by this plan.

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1 Introduction to the Raritan Piedmont Wildlife Habitat Partnership

The Raritan Piedmont Wildlife Habitat Partnership (RPWHP) represents a broad coalition of stakeholders that encompasses 15 townships (for a full list of municipalities included in whole or in part in this area, see Appendix A) in the Central Piedmont Plains of New Jersey (see Appendix B; Map 1). The RPWHP's mission is to insure the prompt and effective implementation of New Jersey's State Wildlife Action Plan (SWAP) by promoting the selection, design, and completion of strategic, science-based habitat preservation, restoration and enhancement initiatives through collaboration among public agencies, non-profit organizations, and private landowners. Accomplishment of this mission will result in the conservation of unique natural resources of the Raritan portion of the Central Piedmont Plains, protection of the quality of life for its residents, preservation of natural areas and farmland, protection of the quality and quantity of water resources, and promotion of eco-tourism and environmental education.

The SWAP segregates New Jersey into five landscape regions; the five regions are further separated into Conservation Zones that allow more detailed description of habitat threats and conservation goals. Lying within the larger Piedmont Landscape Region, the Central Piedmont Plains is the second largest Conservation Zone specified in the SWAP. The RPWHP was formed in recognition of both the unique examples of critical natural resources endemic to the Central Piedmont Plains that face increasing pressure from development and in an attempt to demonstrate implementation of the SWAP. The Partnership unifies a number of successful public and private initiatives independently working towards preservation in the region.

The SWAP specifically notes the significance of both large forest patches and agricultural grasslands (defined as croplands, pastures, hayfields and other agricultural uses) in the Central Piedmont Plains. The Piedmont Landscape contains 115,537 ha of agricultural land, with over 36,000 ha within the Central Piedmont Plains. As stated within the SWAP, this large agricultural matrix "presents great management opportunities and currently supports area-sensitive grassland species," (NJ SWAP Version 8/03/05, p. 298).

Some of the largest and most important agricultural/grassland complexes in the State are still found within the Raritan Watershed of the Central Piedmont Plains Conservation Zone including one of the best grassland examples in New Jersey located at Duke Farms in Hillsborough. In fact, although the region encompassed by the RPWHP accounts for just over 6% of New Jersey's agricultural lands, it contains nearly 9% of the best remaining examples of grasslands in the State (NJDEP Landscape Project Analysis 2006). The initial emphasis of the Partnership focuses on the protection, enhancement and restoration of these critical grasslands of the New Jersey Piedmont Landscape. As noted, other significant habitat types do exist within the New Jersey Piedmont, but the large agricultural complexes are particularly notable. Large, agricultural landscapes

within the project area once contained the most significant grasslands in New Jersey (Wander 1981; 82); and the former extent and species diversity of these sites likely ranked them as one of the best examples of grassland landscapes in the Northeast.

Successful achievement of the habitat restoration and preservation goals of the Grassland Conservation Plan will require a comprehensive implementation strategy that addresses three critical elements:

- Application of appropriate management of critical habitats to public land.
- Engagement of private landowners in conservation actions on priority lands through collaborative conservation agreements, and by providing a modest amount of loan capital to maximize the participation of key landowners in federal and state reimbursement programs which provide payments for habitat enhancement measures on private lands.
- Targeted acquisition of critical habitat parcels as identified by the Grassland Conservation Plan.

The RPWHP represents a unique assemblage of conservation partners, each complimenting the strengths of the others, to adequately occupy niches required for successful implementation of the Grassland Conservation Plan. Key partners who will play a principal role in the implementation of the Grasslands Conservation Plan include the NJ Audubon Society (NJAS), NJ Conservation Foundation (NJCF), the D&R Greenway Land Trust (DRG), the Conserve Wildlife Foundation, the Duke Farms Foundation, and the Endangered and Non-game Species Program of the New Jersey Department of Environmental Protection (NJDEP). A detailed description of several of these key partners can be found in Appendix A.

2 Goals of the Raritan Piedmont Wildlife Habitat Partnership

The RPWHP's mandate is to develop project goals that address the specific threats facing natural habitats and disrupting conservation initiatives within the focal area. The project goals for the RPWHP are derived directly from the Conservation Actions for the Central Piedmont Plains detailed within the SWAP. Specific Conservation Actions from the SWAP addressed within this Grassland Conservation Plan are listed in Table 1 (Appendix C). Specific goals for the RPWHP Grassland Conservation Plan are to:

1. Prioritize tracts for conservation based upon wildlife needs, and maximize the acquisition or restoration of key tracts by public and private partners.
2. Address patch size and connectivity requirements of grassland birds within the prioritization scheme.
3. Develop numerical habitat and population goals for target species within the project area.
4. Develop an implementation plan that fully integrates sustainable agriculture with grassland wildlife preservation, thus making farmers a key part of the solution.

5. Increase face-to-face outreach with key private landowners and farmers in order to boost participation in the applicable federal and State conservation programs.
6. Collaborate with the Farm Service Agency and Natural Resource Conservation Service (U.S. Department of Agriculture), State Department of Agriculture, Rutgers Cooperative Extension and other interested parties to tailor existing conservation programs to be more wildlife friendly.
7. Develop a specific funding mechanism to increase grassland creation and maintenance within the region.
8. Develop recommendations for habitat maintenance that include fire, conservation grazing, and an appropriate mowing regimen.
9. Develop a monitoring and evaluation plan to measure the project's progress towards achieving its goals.

3 History and Current Status of Grasslands

The focal area defined by the RPWHP clearly underscores both the need and justification for a landscape level grassland preservation initiative in New Jersey. While possessing some of the best examples of agricultural grasslands in the state, the Raritan Watershed also offers some of the worst scenarios of the threats and resultant destruction facing New Jersey's grasslands. The project region lies entirely within Hunterdon and Somerset Counties, two of the three fastest growing counties in New Jersey over the past 10 years (U.S. Census Bureau 2000). The Raritan Watershed contains the best grassland site identified by Wander (1981; 82) during a statewide assessment survey of New Jersey grasslands; yet the core of this most important site is currently being destroyed by a large, upscale development of single family homes (see Figure 3, Appendix D).

The agricultural grasslands of the Raritan Watershed offer a firsthand look at what has happened to grassland habitats nationally. In the United States, considering only those ecosystems that have declined in extent by greater than 98 percent, more than half, 55 percent, are grassland habitats including prairies, savannas and barrens (Noss et al. 1995). Furthermore, eastern grasslands, barrens, and savannas rank as one of the 21 most endangered ecosystems in the United States (Noss and Peters 1995). In New Jersey grasslands face an almost immediate threat of complete disappearance from the State.

Threats to farmland are particularly pronounced in the project area, where both development and fragmentation of farmland have accelerated. Total farm acreage in Hunterdon County declined by 4 percent from 1997 to 2002 (USDA 2002). Fragmentation of remaining farmland also increased during the same period with the average size of farms declining from 78 to 72 acres. In Somerset County, the trends were even more severe. The total acreage of farmland declined by 25 percent from 1997-2002 and the average farm size declined by 17 percent (USDA 2002).

Population declines experienced by grassland wildlife mirror the declining trends associated with agricultural habitats they often inhabit. No taxonomic group better exemplifies this than birds. Since 1966, populations of 15 of 19 species of grassland and

savanna birds in the eastern U.S. have declined at alarming rates (Askins 1993). For example, Grasshopper Sparrows have declined at an annual rate of 6 percent, while yearly declines for Vesper Sparrow and Eastern Meadowlark have each averaged 3 percent (Sauer et al. 2005). In New Jersey, data on declines of grassland birds are similarly dramatic. Twenty percent of the State's rare wildlife are grassland species. This value includes 41 percent of the State's endangered bird species, 29 percent of its threatened birds, and 16 percent of its birds listed as special concern (NJ ENSP 2004).

New Jersey's remaining grasslands are almost entirely embedded within agricultural landscapes. Historically, grasslands have been a component of New Jersey's landscape since Pleistocene mastodons roamed the coniferous parklands of the eastern United States. Mastodons undoubtedly played a key role in maintaining open, treeless habitats, much like their close relatives, modern elephants, who retard succession by regularly uprooting and ripping up woody vegetation (Askins 2000; Catling 2002; Williams et al. 2004). As the climate warmed, the boreal parkland shifted northward and the giant herbivores succumbed to extinction. Grassland habitats were maintained and/or created by periodic forms of disturbance that included wildfires, beaver activity, severe floods, and extreme weather events (e.g., hurricanes or drought) or edaphic factors such as poor, thin soils or those with poor or excessive drainage (Askins 1993). Eventually, as in all of eastern North America, the creation and maintenance of open, nonforested habitats was greatly influenced by Native Americans who cleared large swaths of land for agricultural fields and villages and often set fire to hunting grounds to improve forage for game and visibility for the hunter.

Eventual settlement of the eastern United States by European immigrants resulted in extensive clearing of forests for farming and likely increased the amount of grassland and early successional habitat to the highest levels since the Pleistocene (Litvaitis 1993). As civilization crept into previously less inhabited areas, fire suppression, flood control, beaver extermination and other interruptions to ecosystem processes struck a heavy blow to many grasslands. High rates of farm abandonment from the late 1800's into the early 1900's triggered a short-term spike in the amount of grassland in the landscape, but as these abandoned farms succeeded into forest, habitat largely disappeared. Today, modern farming practices have all but abolished the fallow fields, lightly grazed pastures, and field borders and other habitats grassland species once depended upon in agricultural landscapes. Factors associated with recent declines in grassland species are primarily associated with intensification of farming practices, including both habitat changes and alteration of farm management practices (Peterjohn 2003). Suitable grassland habitat is scarce. In addition, developers are willing to pay a premium for agricultural land in New Jersey. Farmland offers a near-perfect scenario for developers. It is flat, free of trees and usually blessed with pleasant vistas. Therefore time spent preparing for development is minimal and far less costly.

4 Evaluation of Threats and Obstacles to Conservation of Agricultural Grasslands

The current threats to grassland habitat in the Raritan Watershed are indicative of those faced by grassland habitats throughout the eastern United States. Therefore the threats and discussion of how to adequately address them are relevant and applicable to much of the eastern region of the United States. However, as is the case with most of the environmental issues in this State, most threats are far more pressing and severe in New Jersey where ultimate build-out of all available land is projected over the next 20 – 40 years – the first state where this will become a reality (Lathrop 2000). Following is a discussion of the threats to grassland habitat and the challenges facing conservation of grasslands in New Jersey, followed by a discussion of how this project's goals will seek to address them. Many of these are derived directly from the SWAP.

1. *Grassland and the agricultural landscapes where they occur are prime real estate.*

Many New Jersey grasslands and the agricultural landscapes they are part of are ideally suited for residential or commercial development. Little or no clearing needs to be done and they are usually fairly flat, making these areas prime targets of developers interested in building large-scale, multi-unit complexes. As previously mentioned, the RPWHP contains a significant portion of the most critical agricultural grasslands for wildlife in the State; however the project boundary also lies within two of the three fastest growing counties in New Jersey (Hunterdon and Somerset). In most communities, per acre prices offered by developers to landowners exceed what local or state open space funds can pay. The best way, or sometimes the only way, for a landowner or farmer who no longer farms the land to continue to draw income off of the land is to lease or sell it. Over 50 percent of tillable land in New Jersey is farmed by tenant farmers. This number is as high as 80 percent in some of the northern counties (NJ Dept. of Agriculture, pers. Comm., April 2006). Large acreages in the State are controlled by lease farmers on short-term leases, making them extremely vulnerable to developers since owners can make more money by selling than by leasing to tenant farmers.

2. *Most contemporary farming practices are incompatible with wildlife needs. Altering farming practices must be economically sound.*

Although agricultural landscapes provide the last extant habitat for grassland wildlife, most lands within them are of poor to unsuitable habitat value for grassland birds. Some grassland birds will forage within cropland if it lies adjacent to adequate nesting cover and brood-rearing sites, but it is not an optimal habitat type. The only habitats available to grassland birds in agricultural landscapes are pastures, hayfields, and fallow fields. Hayfields seem to provide the best habitat alternatives; however, contemporary haying rotations are typically not compatible with nesting grassland birds (Bollinger et al. 1990). Most hayfields are planted to nonnative cool season grasses, with first cutting occurring before the end of June. This coincides with the nesting peak for grassland birds and

destroys nests and young. Pastures for horses or cattle are typically grazed too heavily to provide adequate cover for most grassland birds.

New Jersey's farms defy the national trend of corporate farm consolidation, remaining primarily family-owned and operated. With escalating costs of living and competition from larger farming regions (New Jersey's farms make up less than 0.5 percent of all U.S. farms; U.S. Census Bureau 2002), New Jersey's farmers must struggle to maintain solvency, especially when competing against large corporate farms. If grassland species are to continue to exist in New Jersey, an innovative initiative that considers farm economics and culture in addition to wildlife conservation must be launched to supplement the State's commitment to land protection and farmland preservation.

3. Grassland birds are area sensitive, requiring large tracts to nest successfully.

In New Jersey, the number of landscape regions that remain capable of sustaining grassland bird populations are few and diminishing. New Jersey lost 4,000 acres of farmland per year from 1992 – 2002 and what is left is becoming increasingly fragmented (U.S. Census Bureau, 2002). In 1992, 22.6% of New Jersey's farms were approximately 100 acres or larger; but by 2002, only 17.1% of New Jersey farms were greater than 100 acres. These trends have severe implications for grassland birds sensitive to patch sizes and fragmentation. To address the habitat needs of many of New Jersey's grassland birds, large tracts must be converted to suitable habitat in the landscape; yet diminishing acreage of tillable land forces conservation into a position where it is competing with both active farming and development. It is difficult to convince farmers and landowners to convert large patches of valuable agricultural land to grassland habitat. In New Jersey, over 50 percent of farmland is controlled by lessees, many of whom consider taking land out of cultivation for conservation direct competition to farming and their bottom line.

4. No programs specifically exist to target grassland wildlife conservation.

Most of New Jersey's regulatory or voluntary preservation programs such as the Pinelands Comprehensive Management Plan, Highlands Water Protection and Planning Act, Green Acres and Farmland Preservation Program concentrate on the protection of forestlands, water quality, wetlands or farmland. There is no program that specifically targets grassland conservation. New Jersey's Farmland Preservation Program is extremely active and has successfully protected thousands of farmed acres within agricultural landscapes in New Jersey from development and fragmentation. As a result, New Jersey can boast a higher percentage of preserved farms than any other state (17%) (NJ Agric. Trans. Policy Group). However, despite its successes, the Farmland Preservation Program has been unable to reverse continued losses in farmland acreage and fragmentation of agricultural landscapes in New Jersey. Furthermore, its primary objective is the preservation of New Jersey's farms and agricultural heritage. It does not consider or target conservation of farmland wildlife or grasslands. Likewise, most Federal conservation incentive programs available to landowners are supported by the U.S. Department of Agriculture and the 2002 Farm Bill. Although conservation programs can be useful for establishment and maintenance of grasslands for conservation

of sensitive species, most are geared towards erosion control or other practices beneficial to agriculture or water quality, not wildlife habitat conservation. The upcoming reauthorization of the Farm Bill could positively or negatively affect conservation programs. For this reason it is essential to try and create interest in wildlife conservation independent of Federal subsidies by integrating sustainable agriculture initiatives and preservation of agriculture with grassland wildlife conservation.

5. *Many potential sites that could offer or formerly provided grassland habitat have succeeded into other habitat types or been overrun by invasive species.*

All grassland habitats in eastern North America are early successional, requiring some form of periodic disturbance to maintain existing habitats or create new ones. Modern civilization has interrupted most of the ecosystem processes that create and maintain grasslands; therefore natural succession is a great threat to existing grassland habitats. Without periodic disturbance, invasive nonnative and native woody plants encroach into grassland habitats in New Jersey. Many native species including eastern red cedar, pine, sweet gum, scrub oak, blackberry, raspberry, and black locust invade old fields and abandoned farm fields, quickly altering them from a grass-dominated state into a shrubland and eventually a woodland. Invasive plants are also threats to grassland habitats. In natural areas managed for native grasses and forbs, invasive plants such as Canada thistle, multiflora rose, autumn olive, tree-of-heaven, Chinese bush clover, and Japanese honeysuckle can become established and out-compete native vegetation. The preferred management tool for maintaining both native and nonnative fields is fire. Fire is a renewing entity in grasslands, removing old vegetation and stimulating the root systems of the grasses to produce vigorous, new growth. Fire also removes woody shrubs and saplings that invade the grassland, to prevent it from passing into another successional stage. Although fire is preferred, both native and nonnative grasslands can also be maintained through mowing, careful use of herbicide, and light grazing.

6. *Many landowners and farmers are unaware of existing conservation programs that could help establish habitat and benefit them economically or they have been discouraged from enrolling.*

The targeted population, farmers and landowners, is aware that Federal and State conservation programs exist; however the program types and specifics of each are not well known. In addition, several new programs that have become available in New Jersey in the past 2-3 years are virtually unknown to eligible farmers and landowners. Some eligible landowners are discouraged from enrolling because of a perception that they need to go through extensive "red tape" before being accepted into a program. Many landowners are greatly interested in enrolling their property but cannot afford to enroll even in cost-share programs. Although reimbursement is available, the problem is rooted in their inability to produce enough cash on hand to initiate project implementation. The projects operate as reimbursements so landowners must pay out-of-pocket and then be reimbursed. This is simply impractical for many farmers lacking the capital to pay out-of-pocket.

5 Description of Project Area

The project area encompasses three of the largest agricultural complexes remaining in the Central Piedmont Plains of New Jersey: the East Amwell Grasslands, Orchard Road Grasslands, and the Six Mile Run Reservoir Site. These sites collectively offer 15,050 ha of agricultural land, including 8029 ha ranked as the most critical for habitat restoration in the State (see NJDEP Landscape Project Analysis in subsequent pages). From 1981-82, the last comprehensive Statewide survey for grassland birds in New Jersey determined each of these areas to harbor some of the most significant populations of these species in the State (Wander 1981; 1982). This determination was based upon the presence of most area-sensitive grassland birds targeted by the survey in each of these areas including Upland Sandpiper, the rarest and most area-sensitive of all of the grassland species. The project area (Appendix B; Map 2) encompasses each of the primary sites and attempts to maintain habitat continuity through corridors between each site wherever possible. Following is a more thorough description of each site.

5.1 East Amwell Grasslands

The East Amwell Grasslands lie in the southern portion of Hunterdon County, making up the northern border of the Sourland Mountains. The Grasslands occupy portions of four municipalities, but the majority of the grassland falls within East Amwell Township with significant portions also lying in Raritan and Delaware Townships. The Neshanic River, a major tributary of the Raritan River, flows through the center of the site. The East Amwell Grasslands is the largest of the three agricultural complexes targeted by the RPWHP, encompassing over 4800 ha. It is also the one least impacted by development up to this point. Agricultural commodities in the region include vegetables, horses, orchards, vineyards, and nurseries. East Amwell has demonstrated a strong commitment to maintaining its rural heritage with an aggressive farmland preservation program that has preserved 1761 ha. The East Amwell Grasslands have been identified as a high conservation priority by five separate conservation assessment and planning initiatives: 1) the NJ SWAP specifically noted "Work with local governments and the Natural Heritage Program to protect and enhance the open farmlands at East Amwell Grasslands Macrosite," as a Conservation Action Priority within the Central Piedmont Plains, 2) the Department of Environmental Protection's Endangered and Nongame Species Program (NJ ENSP) completed an analysis of its Landscape Project Data (the Landscape Project is an extensive database of rare species locations and habitat) in 2005 and determined the East Amwell Grasslands to be one of the best remaining examples of agricultural grasslands in the State 3) from 1981-82, the last comprehensive Statewide survey for grassland birds in New Jersey determined the East Amwell Grasslands to be one of the most important in the State for the protection of grassland birds (Wander 1981; 1982), 4) the New Jersey Office of Natural Lands Management (NJONLM) designated the site as a New Jersey Natural Heritage Priority Site due to its significance for grassland wildlife. The NJONLM designates the distinction of Natural Heritage Priority Site only to areas representing some of the best remaining habitat for rare species and exemplary natural communities in New Jersey. The NJONLM further stated that these areas should be considered to be top priorities for the preservation of biological diversity in New

Jersey, 5) the Important Bird Area program coordinated by the New Jersey Audubon Society has identified the East Amwell Grasslands as one of the most important sites for birds in New Jersey.

5.2 Orchard Drive Grasslands

The Orchard Drive Grasslands lie mostly within Hillsborough Township in central Somerset County. The Raritan River marks its northern boundary while the South Branch of the Raritan River occupies the western boundary. In the early 1980's this site was New Jersey's Serengeti – the best grassland site in the State. Wander (1981; 1982) found it to be the only site in the State that contained all rare grassland birds that he targeted during his survey. The western and eastern fringes of this site both contain the best current examples and future opportunities for large grassland restoration. Duke Farms, the former estate of James Buchanan Duke and, later, his daughter Doris Duke, contains over 1200 ha on the eastern end of the grasslands including some of the largest grassland patches in New Jersey. On the western end, the Confluence Reservoir Site, managed by the NJ Department of Environmental Protection and an adjacent farm recently purchased by Branchburg Township, contain large tract sizes and offer tremendous potential for grassland restoration. Hillsborough Township also owns scattered open space tracts throughout the area, some of which offer great potential for grassland restoration.

Like the East Amwell Grasslands, the Orchard Drive Grasslands have also been determined high conservation priorities by several conservation assessment and planning initiatives: 1) the Department of Environmental Protection's Endangered and Nongame Species Program completed an analysis of its Landscape Project Data (the Landscape Project is an extensive database of rare species locations and habitat) in 2005 and determined the Orchard Drive Grasslands to be one of the best remaining examples of agricultural grasslands in the state, 2) as previously mentioned, from 1981-82 the last comprehensive Statewide survey for grassland birds in New Jersey determined the Orchard Drive Grasslands to be the most important in the State for the protection of grassland birds. It was the only site containing all rare species sought during the survey (Wander 1981; 1982), 3) the New Jersey Office of Natural Lands Management (NJONLM) designated the site as a New Jersey Natural Heritage Priority Site due to its significance for grassland wildlife. The NJONLM designates the distinction of Natural Heritage Priority Site only to areas representing some of the best remaining habitat for rare species and exemplary natural communities in New Jersey. The NJONLM further states that these areas should be considered to be top priorities for the preservation of biological diversity in New Jersey, 4) the grasslands on Duke Farms, on the western end of the Orchard Drive Site, became the first site accepted by the Important Bird Area program coordinated by the New Jersey Audubon Society, officially recognizing it as one of the most important sites for birds in New Jersey.

The Orchard Drive Grasslands is perhaps the best example of why a comprehensive grassland plan is needed. Today, the western core of the Grasslands, particularly noted by Wander for its concentration of Upland Sandpipers, has been completely destroyed by

a large luxury home development. Residential development has encroached into much of the site. Despite this, it remains a critically important site almost entirely due to the vast grassland acreages present on Duke Farms.

5.3 6-Mile Run Reservoir Site

The 6-Mile Run Reservoir Site was created in the 1970's when the New Jersey Water Supply Authority bought over 1215 ha , mostly consisting of farmland, for the future development of a shallow water reservoir to serve Central New Jersey. Nearly all of the land lies within central Franklin Township. The reservoir was never built and no current plans exist to do so in the near future. NJDEP now controls the 1215 ha parcel and has been mandated by a 2003 resolution by the Legislature to create a management plan for the property (Assembly, No. 2070, adopted December 15, 2003). The 6-Mile Run site has truly been a blessing in disguise for rapidly developing Franklin Township. Without it, undoubtedly most of the 1215 ha it encompasses would have been developed.

Franklin Township possesses a very strong commitment to land preservation. Despite the rapidly expanding residential development that is destroying much of its open land, the Township has managed to protect nearly 33% of its land base as open space or preserved farm. A total of 3470 ha are preserved as open space (including 6-Mile Run and D & R Canal State Park) and an additional 255 ha are preserved farmland. The Township's commitment does not end with land preservation. It is also striving to be a stewardship leader, demonstrating appropriate management of open space. Franklin Township has been working with the New Jersey Audubon Society since 2003 to develop a habitat restoration and passive recreation plan for two of its largest open space parcels (NJAS 2004). Each involves restoration of significant native grasslands. The Griggstown Greenway includes restoration of a 20-ha patch of native grassland. The Negri-Nepote Native Grassland Preserve will restore a 45 ha patch of native grassland in the center of the 6-Mile Run Site. This site provides the best existing demonstration area for native grassland restoration in the entire project area.

Like the East Amwell and Orchard Road Grasslands, the 6-Mile Run Reservoir Site has also been identified as a high priority for grassland bird conservation by several conservation assessment and planning initiatives: 1) Wander (1981; 82) noted that the 6-Mile Run Site contained the largest concentration of the State-endangered Vesper Sparrow found during his statewide survey, 2) the Department of Environmental Protection's Endangered and Nongame Species Program completed an analysis of its Landscape Project Data (the Landscape Project is an extensive database of rare species locations and habitat) in 2005 and determined the 6-Mile Run Reservoir Site to be one of the best remaining examples of agricultural grasslands in the State. Because of its geographic location, size and condition (it is mostly open, nonforested land), the 6-Mile Run Reservoir Site offers the best opportunity to manage a large grassland network on public land in New Jersey.

6 Developing Population and Habitat Goals for the Raritan Piedmont Wildlife Habitat Partnership

This plan attempts to identify species and habitat goals based upon existing, peer-reviewed methods used in other regions. Ultimately the project's intent is to create a replicable model that can be used to evaluate grassland habitats and assign population goals in other landscapes in New Jersey, in fulfillment of the SWAP. To develop the model, existing initiatives were evaluated and refined to fit the environmental conditions presented by the Central Piedmont Plains.

6.1 Assumptions:

To develop habitat and population goals for grassland birds within the Raritan portion of the Central Piedmont Plains, this plan relies upon the following assumptions:

1) The target species are either neotropical or short-distance migrants, therefore dispersal between occupied habitat in New Jersey occurs frequently enough to maintain genetic viability between and amongst breeding groups in all regions of the State.
2) All local populations of target species in the New Jersey Piedmont readily exchange genetic material through dispersal.
3) At a minimum, the RPWHP boundary encompasses a metapopulation of the target species that likely extends beyond the project boundary.
4) Because of a ready exchange of genetic material with other local populations, genetic viability can be assessed at the regional scale.
5) The population estimates provided by the Partners In Flight North American Landbird Conservation Plan (Rich et al. 2004) and the assumptions underlying them are reasonable estimates that provide the best data available for setting population goals (Rich et al. 2004).
6) The target species occur throughout the landscape in suitable nesting habitat at the prescribed densities reported in this plan. If data suggesting true densities different from the assumed levels become available, then the habitat goals will need to be readjusted accordingly.

6.2 Setting Conservation Targets and Management Priorities

For years organizations across the country and foreign conservation partners have attempted to develop and implement the best conservation models to reverse universal declines of North American bird populations. Many participants agree that what is most needed is a "biologically based, spatially explicit strategy to create and carry out optimal landscape designs to sustain bird populations" (NABCI 2006). But much thought and debate have been waged over what form this strategy should take.

Mueller et al. (1999) offered one of the first methodologies for developing discrete, quantifiable regional conservation plans and goals for upland, nongame bird populations

in North America. While acknowledging the scientific limitations such planning encompasses, they attempted to model proven protocols for goal setting established by game bird initiatives, particularly the North American Waterfowl Management Plan (NAWMP 1986). These methods rely upon consideration of the minimum viable population (Shaffer 1981) (or in the case of game birds optimal population levels) for a species and extrapolating from the amount of habitat and size of each habitat patch required. While keenly aware of the absence of firm scientific information to quantify conservation issues, Mueller et al. (1999) called for adaptive management that makes "conservation recommendations as soon as possible, based on the best information currently available" and promised to modify recommendations as newer, better information became apparent.

This approach acknowledges the reality of modern-day conservation that, "if we wait to collect and analyze all of the information that we think is needed to develop conservation goals and objectives, the opportunity for effective conservation action may be lost" (Mueller et al. 1999). There is no clearer reality in New Jersey than this, where the threat of build-out of all available land is projected over the next 20 – 40 years – the first state in the country where this will become a reality (Lathrop 2000).

The data available to delineate numeric population goals and identify critical habitat have greatly increased and improved since 1999. There are many other tools not available to Mueller et al. (1999) that can now be utilized to set and refine population goals for landbirds. For example, better information on species population estimates and how to use them to set conservation goals is now available and GIS technology has greatly advanced in the past 7 years to the point where habitat quality and quantity can be assessed at the landscape scale between regions.

The lack of population estimates for targeted species was actually one of the weaknesses specifically identified by Mueller et al. (1999) that can now be addressed. The Partners In Flight North American Landbird Conservation Plan (Rich et al. 2004) has established continental priorities and objectives that have, in turn, been defined at the state and regional level for integration into the State Wildlife Action Plan process (Rosenberg 2004). This "step-down" method for assigning population goals to discrete regions or states has long been a technique employed for waterfowl through the Joint Ventures, the implementation vehicles for the North American Waterfowl Management Plan and subsequent North American Wetlands Conservation Act. The PIF Continental Plan makes available, for the first time, a starting point at which practitioners can develop specific population goals for upland, nongame birds.

The novelty of this approach for nongame bird conservation planning is clearly evident. In February 2004 and April 2006, two national workshops were held by Partners In Flight focusing on how to translate the population estimates from the Continental Plan into answers to the questions of: *How much habitat? Where should the habitat be located?* and, *What is the timeline for protecting, restoring and creating it?* To facilitate translation of the continental population objectives into biologically sound, measurable, regional local population-based habitat targets, a *Five Elements Process* for designing

optimal landscapes to meet bird conservation objectives was proposed (Will et al. 2005). The *Five Elements* represent a process "by which biologically-based, spatially explicit, landscape-oriented habitat objectives can be developed for supporting and sustaining bird populations at levels recommended through the objectives set by PIF." The *Five Elements Process* further offers a practical approach that helps conservation partners work together to assess current habitat conditions and ownership patterns, evaluate current species distribution and bird-habitat relationships, and determine the appropriate locations capable of providing enough of a particular habitat type to meet conservation goals.

The *Five Elements Process* repackages proven conservation planning strategies proposed in earlier initiatives including those by Donovan et al. (2000) and relies heavily on techniques of conservation planners from the Lower Mississippi Valley Joint Venture (e.g. Mueller et al. 1999) and the Prairie Potholes Joint Venture. The *Elements* approach first requires development of habitat and population goals as a preliminary step. To fulfill this necessary first step, the RPWHP Conservation Plan follows both the recommendations of Rosenberg (2004) who derived population goals from the Continental Plan specific to New Jersey and Altman (2004) who provided examples on how to use these estimates locally. Rosenberg (2004) recommends adherence to Mueller et al.'s basic model for goal setting, in the absence of better, more local data. The RPWHP plan uses the techniques offered by Mueller et al. and the LMVJV to develop preliminary habitat and population goals, and then uses the *Five Elements Process* to further address an implementation strategy and delineation of priority areas.

6.3 Model Process for Setting Bird Conservation Goals

The 6-step process used by Mueller et al. (1999) to set population and habitat goals for the Mississippi Alluvial Valley remains a solid model that can be refined by newly available techniques and information.

> *Step 1: Establish species priorities.*
> *Step 2: Establish habitat priorities.*
> *Step 3: Identify habitat requirements to maintain individual populations of priority species groups in priority habitats.*
> *Step 4: Determine the extent and location of existing habitat suitable for meeting the habitat requirements of individual populations of priority species.*
> *Step 5: Set site-specific habitat objectives.*
> *Step 6: Set meta-population goals.*

The Five Elements Process recently proposed by Partners In Flight, mirrors much of Mueller's methodology, after preliminary setting of population and habitat goals, but elaborates further to include specific guidance towards implementation.

> *Element 1: Landscape Characterization and Assessment.*
> *Element 2: Bird Population Response and Modeling.*
> *Element 3: Conservation Opportunities Assessment.*

Element 4: Optimal Landscape Design.
Element 5: Monitoring and Evaluation.

The RPWHP follows Mueller's basic steps in the development of habitat and population goals for the target species blended with the concepts put forth in *The Five Elements*.

Step 1: Establish Species Priorities

Because the SWAP incorporates the priorities of all national plans (see p. 48 of the NJ WAP) it is the most comprehensive source for clearly defining species priorities for any part of New Jersey. For this region, the Central Piedmont Conservation Zone, the SWAP provides a comprehensive list of all Federal and State-endangered and -threatened species as well as others of State and Regional Conservation Concern. These lists will serve as the targets for the RPWHP (see Table 2; Appendix C). Birds listed as State and Regional Conservation Concern have been identified by the Continental Plan previously mentioned (Rich et al. 2004).

Step 2: Establish Habitat Priorities

As discussed previously in detail in the Project Area description, the agricultural grasslands in the Raritan Watershed are some of the most important in the State. Historically these were likely of significance at the regional level as well due to the overall diversity and numbers of grassland birds formerly occupying the Central Piedmont. In New Jersey, the Central Piedmont is one of the few Conservation Zones where every State-Threatened and -Endangered grassland species formerly nested. The primary grassland species identified as targets within the SWAP are listed as Threatened, Endangered, or of Conservation Concern in most states of the Mid-Atlantic and New England. Taking these points into consideration, in 2005 at the initial meetings of the planning committee for the RPWHP, the decision was made to focus on the grasslands as the first conservation initiative for the project. With grasslands selected as the initial habitat priority, the target list can be narrowed. The grassland species target list is included in Table 3, Appendix C.

The list is clearly dominated by grassland nesting birds. Based upon population estimates for these species and historical information about their abundance, we have further broken the targets down into primary and secondary targets, as indicated by Table 3. Primary targets are defined as species with clear historical or current records of regular nesting in the area. Secondary targets are defined as species whose historic or current nesting status is unknown or those considered rare or extralimital. Secondary targets also include species whose primary occurrence in the area is during the nonbreeding season.

Step 3: Identify habitat requirements to maintain individual populations of priority species groups in priority habitats.

A final, critical preliminary step for spatially explicit conservation planning must involve the actual setting of population and habitat goals.

All grassland birds considered to be of conservation concern in North America demonstrate some level of area sensitivity – that is, requiring some minimum habitat patch size before they will choose to nest on a site. But conservation of grassland nesting habitat is also an issue of quality, not just quantity. Debate exists as to how much of a negative influence habitat edge has on the quality of habitat, but it is at least clear that for some species, edge habitats greatly influence the viability of a patch. Therefore conservation objectives must be sure to include not only enough habitat to support a viable source population of the target species, but also provide that habitat in an appropriate condition and configuration.

Some types of edge may be more deleterious than others to nesting grassland birds. For example, urban/suburban interfaces have been shown to negatively affect grassland birds (Bock et al. 1999; Cooper 2002). Most agricultural edges appear to have a neutral effect on adjacent grasslands, whereas forested edges directly discourage nesting and create greater threats for nesting birds, who often face higher predation and brood parasitism rates along grassland/woody edges (Winter et al. 2000; Fletcher and Koford 2003; Bollinger and Gavin 2004; Jensen and Finck 2004). Grassland birds may visually perceive that an agricultural crop is similar to the nesting habitat, although too sparse and barren for nesting, while forests have an opposite effect, clearly creating both a visual and physical obstruction that a grassland bird will not move through.

Not only is there debate over the intensity of the impact edges have on grassland birds, but also over how distant from an edge grassland habitat must be before it becomes attractive or productive as nesting habitat. Fletcher and Koford (2003) found that Bobolink density increased as a function of distance from edge for all edge types. Others have reported actual minimum distances at which negative edge effects begin to lessen. Burger et al. (1994) found that artificial nests placed in tallgrass prairie <60 m from a woody edge were depredated more than those further away. Winter et al. (2000) reported that success of artificial and natural nests increased >30 m from a forest edge and >50 m from a shrubby edge, respectively, in tallgrass prairie. Johnson and Temple (1984; 1994) found nest success in tallgrass prairie >45 m from a forested edge to be higher than that of nests nearer to the edge. Jensen and Finck (2004) found no difference in nest success at various distance intervals from forested edge, but found that brood parasitism was much higher <50 m from a forested edge. Dickcissel nesting density was also lower <50 m from the edge. Thus, the body of literature suggests that edge effects are apparent in grasslands and can be expected to negatively affect nest success or site selection up to 35 - 60 m inward from a woody edge.

Based upon the extensive body of literature looking at the effects of habitat fragmentation and the accompanying increase in edge habitat that it creates for nesting birds in a variety

of habitat types, it appears that edges do create a problem for grassland birds. Therefore this project used the same error correction proposed by Mueller et al. (1999) to account for edge effects in setting habitat acreage goals, with adjusted values for the edge variable to make it relevant to grassland habitats (the original analysis was of forested habitats).

Mueller et. al (1999) used the following formula to calculate patch size requirements for theoretical genetically viable populations of most forest nesting species:

$$A = (N * D) + B$$

A = area of habitat patch required to support a source population, N = number of reproductive units (breeding pair), D = breeding density (usually expressed as ha/breeding pair), and B = the correction factor for habitat edge, the area of a 1 km forested buffer around the forest core (forest core = N * D). Rosenberg (2004) recommended use of A = (N * D) as a starting point for setting habitat goals using the population estimates provided by the Continental Plan (2004) until a better method is developed.

Will et al. (2005) further recommended that the end product of *Element 2* be spatially explicit habitat goals supportive of population objectives, further stating that these objectives should be presented in terms consistent with monitoring and evaluation parameters. These parameters should be reflective of vital rates other than abundance (e.g., recruitment, survival, reproductive success). Data on these vital parameters are often not available and difficult to obtain. Considering this, the RPWHP plan attempts to make vital parameters an integral part of our goal setting model, thus adding to the suggestions of Rosenberg (2004), by including the correction factor B. Use of B in the model takes vital parameters into account because it considers factors negatively influencing vital population parameters of the target species locally by incorporating edge effects and selecting only the best, core habitat. Given the overwhelming evidence of the negative influences of woody edge on grassland birds and existing landscape condition of the Central Piedmont Plains, using a correction factor seems to be a more appropriate action for setting goals and identifying the most critical habitats than simply using the *A = (N * D)* equation.

This project relies upon the rules set forth by Rosenberg's (2004) tiered approach based upon population estimates from the Continental Plan (2004) to establish overall population goals for the project area (N). He further suggests that, "by combining the suggested population objectives with our initial estimates of population size, a first approximation of a numerical population target for each species at the continental, regional, and state levels can be determined". These objectives are set using the following protocol:

- ✓ *Double population* for all species that have undergone severe declines of 50% or more over 30 years over the next 30 years.
- ✓ *Increase population by 50%* over the next 30 years for all species that have undergone moderate declines (15-50% over the past 30 years).

- ✓ *Maintain/Increase Population* over the nest 30 years for species with uncertain or unknown past trends.
- ✓ *Maintain Population* for species with stable or increasing populations.

The NJAS, NJ ENSP, and U.S. Fish and Wildlife Service developed State population estimates for New Jersey's land birds using estimates provided by the PIF Continental Plan (see Appendix A for a complete list of these population estimates). Using the protocol set forth by Rosenberg (2004), Statewide population goals were developed for each of the RPWHP project's target species. These goals are presented in Table 4, Appendix C. These Statewide population estimates provided a starting point for setting population estimates for the RPWHP. Because the RPWHP contains roughly 10% of the best examples of grassland habitats in the State (see GIS analysis in the following section), this percentage was used as a general guide for stepping the population goals down to the RPWHP region. Actual population goals for primary targets within the RPWHP project area are available in Table 4. The 10% rule was applied for Eastern Meadowlark, Grasshopper Sparrow, and American Kestrel. However, because the nesting range of Bobolink does not extend into the southernmost region of New Jersey (Bobolinks are rare or absent from most habitat patches there [Walsh et al. 1999]), the Bobolink population goal was weighted up to 15% of the Statewide goal. For Savannah and Vesper Sparrow, the Statewide population objectives were extremely low, 300 and 234 pair, respectively. We decided that, at a minimum, total goals for Landscape Region (e.g. the Piedmont) should at least reflect the 250 pair estimated by Franklin (1980) as a minimum viable population level for passerines. Thus, we set goals of 60 breeding pair each for Vesper Sparrow and Savannah Sparrow, as the RPWHP contribution to the Piedmont Landscapes population of these species.

To determine an appropriate value of D, (or breeding density) for each target species the existing literature was consulted on each species. Two thorough reviews of the literature on individual species written and published over the past 10 years greatly aided this determination. The Birds of North America includes an extensive literature review and summary for every breeding species in North America (Birds of North America). In addition, the U.S. Fish and Wildlife Service reviewed over 5,500 individual pieces of literature on grassland species to develop species summaries in 2003 (Dechant et al. 2003). Both synopses thoroughly review the literature on all target species. In addition, literature published on these species since publication of these documents was reviewed. Appendix A contains a short summary of ecological needs for each target species based upon the literature review along with a short description of each of the primary target species. Table 5, Appendix C lists the D values (presented as average territory size for a nesting pair) calculated for each of the target species along with a summary of other ecological traits derived from the literature review.

For the edge correction value of B, Mueller et al. (1999) chose to use a 1 km buffer. Lacking the capability to apply this to forest patches throughout the region of varying configuration, they also chose to apply a doubling factor in which the final estimate of A was doubled to account for the 1 km buffer. As evidenced by the earlier review of relevant literature on the subject of edge effects in grasslands, edge effects in these

habitats are evidenced at a scale much lower than forests. For this project, the B value was set at 50 m, an extremely conservative figure derived from the literature.

A 50 m buffer was applied from a woody or urban edge to all grassland patches identified by the GIS analysis. No buffer was applied to a cropland edge. This was based upon the earlier discussion of the impacts of woody edge on grassland nesting birds and the apparent lack of an effect at agricultural edges. Application of the buffer identified the extent of "core grassland" acreage available within the project area. The GIS analysis used to identify the best examples of core grassland in the region is explained in detail in the following section.

Evaluating Validity of the Models Used to Set Population and Habitat Goals

Each of the national, regional, and technical descriptions pertaining to avian conservation planning that are referred to in the RPWHP Conservation Plan state the extreme importance of validating the assumptions, techniques and estimates with local data for bird populations (Will et al. 2005; Rich et al. 2004; Rosenberg 2004; Mueller et al. 1999). They each concede, however, that the type of data needed is rarely available.

The RPWHP plan has access to two local datasets from New Jersey with two years of monitoring data on nesting density, nesting success, and species occurrence in each. One of these datasets was even collected from a key site within the RPWHP region – Duke Farms. The other was collected at the Atlantic City International Airport in southern New Jersey. Although sample sizes were too small to allow comparisons for most of the RPWHP targets, one of the most common of the primary targets, Grasshopper Sparrow, had a sample size large enough at both sites for comparison with the RPWHP modeling for this species (Seigel and Lockwood 2006; Mizrahi et al. 2006).

In the first two years since publication of the Continental Plan, one common reaction among reviewers has been that habitat acreages proposed have been too low (Dettmers pers. comm. 2006). Although the New Jersey datasets that the RPWHP has access to focus on two discrete sites and not a landscape region, data collected during these studies on Grasshopper Sparrow suggest that the habitat goals proposed to meet the population goals are accurate, and possibly even overestimates of the amount of habitat that might be needed.

For example, distance sampling and territory mapping of one of the largest individual grassland patches in New Jersey at Duke Farms, reported a conservative estimate of 30 nesting pair of Grasshopper Sparrow in a 60-hectare patch (nesting density one pair per 2 hectare, Seigel and Lockwood 2006). In addition, a territory size of 0.51 hectare was reported. At Atlantic City Airport, another one of the State's largest patches of grassland, territory mapping used in conjunction with distance sampling provided an estimate of 118 nesting pair of Grasshopper Sparrow within a 117-hectare grassland patch (nesting density of one pair per hectare, Mizrahi et al. 2006). Territory size was calculated in two different ways providing mean estimates of 0.6 and 1.6 hectares. These data suggest that

the density value (D) used within this plan to calculate the habitat acreage goals for Grasshopper Sparrow (1 pair/2 hectares) are realistic numbers, and, potentially, may be overestimates, especially considering that the goals apply to core hectares only and not to the 50 meters surrounding them. Because the 50 m buffer is also a conservative estimate that exceeds the distance reported for area effects by several studies in grassland habitats, it is likely that the core habitat identified by the RPWHP might provide viable habitat for a greater number of Grasshopper Sparrow than indicated by the project's goals. Therefore, based upon the data provided by these two recent New Jersey studies of Grasshopper Sparrow, the RPWHP believes its population and habitat goals to be reasonable. All of the population estimates developed for the RPWHP Conservation Plan should be revisited as additional data becomes available for the primary targets and restored acreage and adjusted if necessary.

Step 4: Determine the extent and location of existing habitat suitable for meeting the habitat requirements of individual populations of priority species.

Discussion of Existing Conservation Initiatives and Methodologies

Seemingly, one of the best examples of a project analogous to the Raritan Piedmont Wildlife Habitat project that sets specific habitat targets is the Grassland Bird Conservation Area (GBCA) construct developed by Partners In Flight (Fitzgerald and Pashley 2000). The concept attempts to meet the needs of all grassland birds deemed targets at all relevant spatial scales. The PIF GBCA model called for identification of a 800-ha core of quality grassland within a 3200-ha matrix (or 1.5 km buffer) containing another 800-ha of quality grassland in blocks of at least 40 ha. Desired forest cover was to be less than 1% in the core and less than 5% in the matrix. The GBCA was developed for a large, grassland-dominated landscape and obviously cannot be directly translated into a conservation initiative away from large prairie regions, especially eastern grassland regions where forests are always an important component of the landscape. However, the GBCA does provide a solid framework to consider for grassland conservation.

Even within landscapes historically dominated by prairie, the GBCA concept has often been deemed too restrictive for meaningful conservation initiatives. Grassland bird biologists working with the Prairie Pothole Joint Venture (PPJV) determined the GBCA criteria too restrictive due to extensive fragmentation of the tallgrass prairie (Casey 2005; HAPET). The PPJV includes the states of Iowa, Minnesota, Montana, North Dakota and South Dakota in addition to the Canadian provinces Saskatchewan, Alberta, and Manitoba. The PPJV decided to keep the GBCA approach, but altered the criteria to include a tiered approach, with Type 1 grasslands meeting the needs of all of the most area sensitive species and Types 2 and 3 meeting the needs of the less restrictive species. Subsequently, the GBCA was recast for the PPJV to better fit the condition of the landscape and reflect more practical objectives. Such a tiered approach is more practical for the Raritan Watershed, where historic grasslands were always of varying size and configuration and forest was also a significant habitat type.

There are obvious differences between the Midwestern landscapes that the GBCA was modeled for and New Jersey agricultural landscapes. In its most basic form, the GBCA was developed as a conceptual model based on large scale landscape characteristics thought to be desirable for a variety of grassland nesting birds. That is precisely what the RPWHP is attempting to accomplish. The RPWHP Conservation Plan attempts to adapt the GBCA method to eastern grassland landscapes by adopting a tiered approach to identify the most critical grassland patches modeled after the PPJV's method and tailored to the grassland species that occur in New Jersey.

Habitat Analysis

Will et al. (2005) listed "Conservation Opportunities Assessment" as *Element 3* and furthered the concept of this step's determination to include a parcel by parcel identification of public and private lands and their current and potential capacity to contribute to the overall population and habitat goals.

The RPWHP Grasslands Conservation Plan followed this framework to ultimately identify parcels currently possessing critical habitat as well as those with great potential to contribute following restoration. To reach this specific data layer, a detailed spatial analysis was used to evaluate existing habitat, potential restoration sites, and larger focal habitat patches.

The grassland layer from Version 2.0 of the Landscape Project provided an excellent starting point for an analysis of habitat in the focal areas (Niles et al. 2004). The Landscape Project is a pro-active, ecosystem-level approach to the long-term protection of imperiled and priority species and their important habitats in New Jersey. Cropland, pasture, and hayfield all are coded as 'grassland' in the Landscape Project. Therefore the grassland layer represents a combination of lands under varying agricultural uses, including those with restoration potential. It is tremendously useful in identifying those areas in the State with the greatest potential for grassland restoration; that being areas dominated by open, primarily agricultural lands where forest is not a dominate feature of the landscape. By definition, these areas overlap with the largest remaining agricultural landscapes in New Jersey.

The output of the Landscape Project is a series of maps of habitat patches coded with species occurrences and a conservation ranking based upon those species records (Map 3; Appendix B). Therefore, a patch of grassland habitat has species records associated with that patch as well as a conservation ranking between 1 and 5. Conservation ranking is defined as:

- ✓ **Rank 5** - patches containing one or more occurrences of at least one wildlife species listed as endangered or threatened on the Federal list of endangered and threatened species.
- ✓ **Rank 4** - patches with one or more occurrences of at least one State endangered species.

- ✓ **Rank 3 -** patches containing one or more occurrences of at least one State threatened species.
- ✓ **Rank 2 -** patches containing one or more occurrences of at least one non-listed State priority species.
- ✓ **Rank 1 -** patches that meet habitat-specific suitability requirements but do not intersect with any confirmed occurrences of such species. Grassland layer minimum size requirement is 18 hectares.

The Landscape Project allows us to mirror the GBCA model employed in Missouri where focal areas were established based upon the occurrence of target species and where the highest percentage of available habitat remained (Jacobs 2005). When describing the three focal areas in the preceding section we noted that each of the three areas had been identified as one of the best remaining examples of an agricultural grassland in the state by an analysis of the Landscape Project in 2005. This analysis provided the dataset needed for the next step to further prioritize known grassland patches.

In 2005, the ENSP performed an additional analysis of the Landscape Project Grassland Layer to not only identify the best remaining examples of agricultural grasslands in New Jersey but also to prioritize those areas with high restoration potential and conservation value. This new layer used Landscape's Conservation Rank as one of the four base variables. This analysis was conducted for the New Jersey Habitat Incentive Team (NJHIT), a coalition of private and public partners formed to promote conservation practices on private land. The NJHIT analysis further prioritized the patches coded with Conservation Ranks 1 -5 with a set of four variables. Patches are displayed, or valued, by the total number of the four variables they are coded for. The four variables selected are as follows:

- ✓ **202 ha grassland** – Patches are coded yes/no if they meet the minimum size of 500 contiguous acres (202 ha).
- ✓ **¼ mile (2/5 km) to open space**- Patches are coded yes/no if they are within 2/5 km to open space. The open space data set used is from the NJDEP Green Acres Program. It includes anything identified as tax exempted open space. The open space designation does not necessarily mean it is grassland open space.
- ✓ **½ (4/5 km) to preserved farmland** – Patches are coded yes/no if they are within 4/5 km to preserved farmland. Again this dataset was provided by NJDEP Green Acres program.
- ✓ **Endangered and Threatened species** – Patches are coded yes/no based upon the Landscape Conservation Ranking. Patches coded 3, 4 or 5 received a "yes" and patches coded 1 or 2 received a "no".

Patches are then displayed by the number of NJHIT variables (out of a possible total of four) they are coded for, which are described below;

0 – Landscape Project Grassland with no NJHIT variables.
1 – Landscape Project Grassland containing 1 NJHIT variable.

2 – Landscape Project Grassland containing 2 NJHIT variables.
3 – Landscape Project Grassland containing 3 NJHIT variables.
4 – Landscape Project Grassland containing all 4 NJHIT variables.

The NJHIT analysis produced a product that identified the largest, most contiguous patches of agricultural grasslands in New Jersey, built upon the Landscape Project's data of locations where grassland birds have been documented (Map 4; Appendix B). Because each of the three focal areas within the Partnership region was identified, the next step was to refine this analysis to delineate the most important tracts of habitat within the focal areas (Map 5, Appendix B).

Starting with the NJHIT modified Landscape Project grasslands, RPWHP further prioritized the patches based upon both grassland habitat characteristics and the needs of the focal grassland bird species throughout the RPWHP region (Table 6). At the time that the RPWHP was conducting this final analysis (June 2006), NJDEP was in the process of updating its land use/land cover dataset using 2002 imagery. The land use/landcover dataset is the basis for the Landscape Project. (Version 2.0 used the 1995 land use/land cover dataset.) The 2002 version is not yet available Statewide, so the ENSP was not able to use an updated version of Landscape Project 2.0 for the analysis. However, to address the dramatic changes that have taken place as a result of development in the RPWHP region, ENSP was able to import the "Urban" data layer from the 2002 land use/land cover dataset. The data layer illustrates those areas that have been developed between 1995 and 2002. The RPWHP chose to erase all newly urban areas from the grassland layer to improve the accuracy of the final product. The entire methodology for the analysis is described in more detail in the next section.

Grassland Habitat Characteristics

Each grassland patch identified by the analysis was coded by total acreage as well as core acreage. Core grassland area within RPWHP has been defined as the following. Patches are buffered by 50 meters from non-grassland edges (mostly woody edges and major roads; agricultural fields are considered grasslands). Buffering of the patches can result in areas of the patch becoming isolated or creating "islands" of habitat. Areas that remain after the buffer has been applied had their acreage calculated (Map 6, Appendix B). In order for an isolated area to be included in the core calculation it must meet a minimum size of 5 ha. This size represents the minimum patch size deemed usable by target grassland bird species, as illustrated in Table 5, Appendix C. All isolated areas meeting that size are summed resulting in the core acreage for that original patch.

Following completion of the analysis that identified core acreage of potential habitat patches, further discrimination of patches helped advance implementation strategies. When grassland patches were buffered inward 50 meters to identify core patches, larger patches of intersecting core habitat were apparent, as were smaller core fragments that were created by the buffer. The term 'Foundation Core Hectares' was created to identify the largest patches created (within the core patch) after the buffer was applied (Map 7, Appendix B).

The initial step to prioritizing specific focal areas within the RPWHP was to identify core patches with a foundation size greater than 150 hectares. Of those, only patches having 2, 3 or 4 NJHIT variables were selected as focal areas. This resulted in the identification of 10 patches to be considered RPWHP Tier 1 focal areas – 5 with four variables, 4 with three variables, and 1 with two variables (Map 8 and 13, Appendix B). Patches having more variables are of a higher priority.

The model was further refined adding information gathered covering the minimum habitat requirements for each of the target species. Each species was then clumped into one of four patch size categories as listed in Table 6, Appendix C. For each target bird species listed in Table 6, each patch is also coded as to the number of pair it could support (based upon minimum habitat requirements from Table 6). Each patch also displays a GIS code which represents the size class of the patch and the bird species it can support. Core habitat patches were classified according to the area requirements of target species that the core acreage could potentially accommodate. Core grassland acreage was used to calculate this number. A species was sorted into its appropriate acreage class based upon its ecological needs. Within this rising scale of area requirements, it is assumed that each larger habitat patch will add additional species while continuing to provide habitat for each species in smaller patch size classes. For example, Eastern Meadowlark and Savannah Sparrow fall within the smallest size category, 5 – 10 ha. The next size category is 11 – 30 ha and adds Bobolink and Grasshopper Sparrow while still accommodating Eastern Meadowlark and Savannah Sparrow. Table 7, Appendix C and Maps 9-12, Appendix B represents an example of these species-specific calculations.

Maps 10 – 16, Appendix B illustrate the focal areas located within the three regions of the Partnership (Amwell Grasslands, Orchard Drive Grasslands, and 6-Mile Run Area). It is assumed that if the amount of core habitat identified in the goals is met, that the RPWHP will make a significant contribution to a viable source population of nesting grassland birds.

Step 5: Set Meta-Population Goals

Mueller et al.'s Step 6 is addressed ahead of Step 5 in this project, following their recommendation. The lack of population estimates prevented them from setting metapopulation goals prior to establishing habitat objectives. However, estimates for New Jersey are now available from the Continental Plan (Rich et al. 2004), allowing this to be considered.

Mueller et al. (1999) set N as the minimum effective population using 500 breeding pair. Franklin (1980) proposed 500 breeding adults (250 breeding pair) as the minimum size required for subpopulations of Red-cockaded Woodpecker within the species' recovery plan based upon demographic research conducted on the species (USFWS 2003). This number has often been accepted as the best available starting criteria for setting a value for MVP for conservation planning for North American upland birds and is frequently

referenced by Partners In Flight plans. Recognizing the peril associated with "establishing conservation goals at the minimum threshold, based upon a series of unverified assumptions," Mueller et al. (1999) recommended doubling the number to 500 breeding pair to address these uncertainties and thereby set adequate population levels. The use of 500 pair as a goal for a minimum viable population has become fairly standard practice in PIF conservation planning.

For many species targeted by the RPWHP, especially those requiring extremely large habitat patches, this Conservation Plan must rely upon the previously stated assumptions that breeding pairs within the region are part of a larger Piedmont Landscape population in order to realistically approach 500 breeding pair. Current population estimates and historic data on distribution of several of our target species (e.g., Upland Sandpiper and Savannah Sparrow) make a goal of 250 – 500 breeding pair unreasonable for the RPWHP planning region. Goals for these species were set at a level that assumes that the RPWHP region could contribute its share to a genetically viable regionwide population in the Piedmont (i.e., for Vesper and Savannah Sparrow) or Mid-Atlantic Region (i.e. Upland Sandpiper) that could meet the 250 – 500 pair target minimum viable population. The RPWHP assumes that this is a reasonable assumption based upon the life history traits of grassland birds, especially in the eastern United States where historic habitats were ephemeral and of varying size and configuration in the landscape.

It is practical to set a goal of 500 breeding pair for Bobolink, Eastern Meadowlark, and Grasshopper Sparrow in the Central Piedmont Conservation Zone based upon the importance of agricultural habitats in this region. Therefore goals specifically set for by the RPWHP Conservation Plan will be significant contributors to the larger metapopulation of the Central Piedmont Plains and the region. For the other targets, however, planning at the State and regional level must consider what number of breeding pairs is needed for long-term maintenance of these species in the landscape. RPWHP goals for this species should greatly contribute to that overall goal.

7 Implementation

Step 6: Set site-specific habitat objectives

Will et al. (2005) lists "Optimal Landscape Design" as the all-important *Element 4.* Once habitat and population goals have been set, this critical step of communicating where and how habitat protection and management can take place truly is what moves the plan into action.

Only a small number of sites within the project area offer the potential for the creation of the largest core blocks capable of supporting all or most of the target species. Most of these are on private land, but four important examples are found on land owned by public entities or non-governmental organizations. These are discussed in more detail in the following section.

Interpreting Project Acreage Goals

With specific habitat goals established for all target species, it is essential to make sure these goals are interpretable into real numbers that can be understood by land managers and partners. It is important to recall that we have made every attempt to be conservative with these goals; therefore achievement of the project's habitat acreage goals should accommodate the population objectives for the target species. Also, habitat for each species need not be managed independently from other species. In many cases habitat for one species can accommodate the needs of other species (see Table 8, Appendix D).

Upland Sandpiper

RHWHP Population Goal: 30 pair.
RPWHP Habitat Goal: 300 hectare core grassland.

A target of 300 hectares of habitat suitable in contiguous patches of at least 30 ha for nesting Upland Sandpiper that can support a project-wide population of 30 breeding pair was set. Upland Sandpiper should be a primary stewardship target on the largest parcels of land available for acquisition and/or stewardship because it requires larger habitat patches than any of the other primary target species. Because of their immense patch sizes, both Duke Farms and 6-Mile Run (including adjacent land owned by Franklin Township) should attempt to manage for Upland Sandpiper. If adequate patch sizes are feasible on other previously mentioned publicly opened patches, Upland Sandpiper should trump all other primary targets. Patch sizes large enough for this species are extremely difficult to acquire and manage as contiguous grasslands; therefore opportunity may drive the chosen locations for this species. To improve patches identified as high priority for Upland Sandpiper, all trees and wooded hedgerows within fields, separating adjacent fields, and extending into the interior of the fields must be removed. Where possible and feasible, small, narrow woodlots should be removed to increase the amount of core nesting habitat available for this and all target species. For example, removal of Kaufman Woods at Duke Farms could immediately double the amount of core habitat available for grassland species.

Some form of disturbance must be employed to maintain the habitat in optimal condition. For Upland Sandpiper, this is more difficult, because Upland Sandpiper require three distinctive vegetation conditions to fulfill three ecological needs: nesting cover, brood habitat, and foraging habitat. These can be addressed through a rotational disturbance regime.

Upland Sandpiper sites should represent the largest tracts that can be assembled within the Partnership boundaries. The grassland can be composed of cool season or warm season grasses, however warm season plantings should be dominated by little blue stem to address the proclivity of Upland Sandpiper to avoid tall vegetation for nesting. Active disturbance is a necessity and can include conservation-grazing, burning or mowing. 20-30% of the habitat should be disturbed annually (for grasslands exceeding 200 acres). Moderate grazing can be employed but should be delayed until after mid-June. Burning

should occur from March – April or October – November. Mowing should be delayed as long as possible, but if necessary to create a crop, should be conducted no earlier than mid-July. Mowing should be done at a height of 15 – 30 cm.

Placement of Eastern Bluebird and Tree Swallow nest boxes should be encouraged throughout Upland Sandpiper sites, but they should not extend above the surrounding vegetation. These boxes would help address the Upland Sandpiper's preference of perches scattered throughout the habitat.

American Kestrel

RPWHP Population Goal – 145 pair.
RPWHP Habitat Goal – Not calculated. Size requirements for this species are highly variable.

A population goal of 145 pair was set for American Kestrel in the RPWHP. To achieve this goal, American Kestrel nest boxes should be placed throughout the entire region, expanding upon the ENSP's nest box program. Boxes could be placed on telephone poles or on poles erected at the edges of suitable habitat that includes open agricultural fields, hayfields, and even large manicured lawns (e.g. schoolyards or golf courses). The normal occupancy rate of nest boxes by kestrels should be determined and the number of boxes needed to achieve the goal distributed. Monitoring of boxes is essential to prevent colonization by European Starlings. Volunteers could be utilized to monitor and maintain boxes.

Grasshopper Sparrow

RPWHP Population Goal – 288 pair.
RPWHP Habitat Goal – 580 hectares core habitat.

A population goal of 288 pair supported within a core habitat of 580 hectares in patches no smaller than 30 hectares was set for Grasshopper Sparrow within the RPWHP. Grasshopper Sparrows occupy grasslands at an early successional stage, reaching peak abundance in the years immediately following a disturbance. Woody vegetation should be eliminated from grasslands managed for this species. 20 – 30% of large patches (> 80 ha) should be treated with disturbance annually with mowing, burning, and light grazing all acceptable. On smaller patches, 50-60% should be disturbed at a time.

Savannah Sparrow

RPWHP Population Goals – 60 pair.
RPWHP Habitat Goals – 30 hectares core habitat.

A population goal of 60 pair supported within a core habitat of 30 ha in patches no smaller than 10 ha was set for the RPWHP region. Savannah Sparrows reach peak abundance 1 – 5 years after a management burn. Trees and shrubs should be removed

from the nesting habitat. Mowing, light grazing, or burning should be applied on a 3-year rotation, with sites > 50 ha having 30 % of their total area disturbed and smaller sites having 50% treated at a time.

Vesper Sparrow

RPWHP Population Goals – 60 pair.
RPWHP Habitat Goals – 100 hectares.

A population of 60 pair of Vesper Sparrow in patches of at least 10 ha supported by 100 hectares of habitat was set for the RPWHP. Vesper Sparrows differ in their habitat requirements from many of the other grassland targets. Edges between field and forest often support this species. A total of 100 hectares of habitat should be managed and created for this species in the plan. This should be a mixture of grassland/forest edge and filter strips placed around agricultural fields. Private lands within the core habitat that remain in cultivation should be targeted for the creation of grassed buffer strips along waterways and field edges to provide habitat for this species. These strips should be mowed or burned every 3 years.

Eastern Meadowlark

RPWHP Population Goals – 153 pair.
RPWHP Habitat Goals - 345 hectares of core habitat.

A total of 345 core hectares of habitat should be managed for Eastern Meadowlark within the RPWHP geographic area to support a population of 153 pair on patches no smaller than 5-10 ha, with larger patches preferred. This species requires grasslands at a later succesional stage, but absent of woody vegetation, and habitat should be burned on a 3-5 year interval. Patches exceeding 80 ha should have 20-30% of the habitat disturbed annually. Smaller patches should have 50-60% of habitat burned at a time.

Bobolink

RPWHP Population Goals – 276 pair.
RPWHP Habitat Goals – 414 hectares of core habitat.

A total of 414 hectares of core habitat should be managed to sustain 276 pair of Bobolink in patches > 10 ha within the RPWHP region, with larger patches preferred. Burning is the preferred habitat management method for this species but light grazing and mowing can also be used on a 2-3 year rotation.

Summary of General Management Prescriptions

In the previous section it was obvious that the management prescriptions for many of the target species are similar. In summary, all habitat managed as grassland in New Jersey must receive some form of periodic disturbance. Grazing, fire, and mowing can all be

useful tools for grassland maintenance; however all must be done with grassland birds as primary priorities and not afterthoughts to livestock or haying needs. Further information should be gathered on how to make these management practices best integrate with avian needs. Until additional local data suggests otherwise, larger grasslands should be managed on a rotation, with 20 – 30% disturbed per year. Disturbance on smaller grasslands should treat 50 – 60% per year (for definitions of 'smaller' and 'larger' review species accounts in Appendix A and Table 9 in Appendix C).

Grasslands with the lowest perimeter to area ratios and thereby higher amounts of core habitat and lesser amounts of edge are the most important targets. The largest available parcels demonstrating this ratio should always be targeted first and managers should always strive to improve the functionality of grasslands of any size by eliminating all woody vegetation including individual trees, small woodlots, shrubs, hedgerows, and fencerows accept where woody vegetation is needed for erosion control (e.g., riparian areas). In addition, if expansion of a managed grassland is not possible, maintenance of habitats that are permeable and either benign or more consistent with grassland cover should be encouraged on adjacent tracks (e.g., rowcrops, hayfields, and pastures rather than forests, shrublands, orchards, Christmas tree plantations, vineyards, or suburban development).

Implementation Strategies

Biologically driven implementation strategies for the RPWHP plan will focus on the three primary attributes addressed by the Partnership:

- ✓ *Effective, economical conservation on private lands.*
- ✓ *Effective stewardship of public land.*
- ✓ *Strategic acquisition of critical habitat parcels.*

Each of these strategies is critical to ultimate fulfillment of the Partnership's goals, and each clearly reflects national conservation issues central to successful implementation of all Wildlife Action Plans.

Effective, Economical Conservation on Private Lands: Stewardship and Outreach

This strategy is particularly critical because the largest core patches identified by the analysis occur in the Amwell Grasslands portion of the project area where private landowners own the majority of the land. Working through a statewide initiative known as the New Jersey Habitat Incentive Team, New Jersey Audubon has been strategically targeting specific townships or clusters of townships throughout the State for proactive outreach to private landowners. This process has been widely successful, resulting in over 500 acres being proposed for enrollment in Federal and State conservation programs to create grasslands in and around Harmony Township in Warren County and creation of a 3-mile riparian buffer restoration along the Delaware River in Salem County. Because Federal and State conservation programs can be tailored to be economically beneficial for

landowners, this strategy has the greatest opportunity to put habitat on the ground quickly. NJAS has developed a specific outreach template and protocol that will be used by the Partnership to proactively contact private landowners possessing critical habitat within the targeted regions. This strategy address threats 1, 2, and 6 from Section 3 of this plan by giving landowners alternatives to selling to developers that make economic sense, and increasing awareness and facilitating enrollment of private land into conservation programs. The effectiveness of this program would be greatly enhanced, and this strategy could also address threat and obstacle 4, if a short-term loan program were established for private landowners that could provide the relatively small amounts of start-up money needed for enrollment into Federal and State reimbursement programs for private lands conservation. This is a critical need, and an innovative means of addressing this problem would have application to the successful implementation of State Wildlife Action Plans not just in New Jersey, but in many other states as well.

Effective Stewardship of Public Land

Because most landowners are unwilling to convert their entire acreages into grasslands, the best (and perhaps only) opportunities to create and manage large tracts for the most area sensitive species will likely be on public land. A number of public lands lie within the project area that could significantly contribute to the overall population and habitat goals if managed appropriately. Likewise, these key public resources could serve as focal demonstration sites for the entire project. The most important of these is the 1215 ha 6-Mile Run Reservoir Site in Franklin Township. However, other significant public parcels that could contribute to overall project goals include properties owned by Franklin Township surrounding 6-Mile Run, the Confluence Reservoir Site managed by the Department of Environmental Protection in Hillsborough and Branchburg Townships and the adjacent River Lea Farm recently purchased by Branchburg as open space, the Merck Wildlife Management Area in Readington Township, as well as several key parcels recently acquired by Hillsborough Township. With such substantial acreage of potential grassland habitat already in public ownership, appropriate management of these parcels could make significant contributions to the overall project goals where scarce resources limit purchase of additional Tier 1 tracts. This strategy addresses threats and obstacles numbers 3 and 5 from Section 3 of this plan by targeting the best opportunities in the region to manage large tracts for grassland birds and establishing well-managed sites that can demonstrate the optimal habitat conditions needed to fulfill the overall goals of the RPWHP Conservation Plan.

Strategic Acquisition of Critical Habitat Parcels

Fee acquisition should be a key strategy on the largest parcels with single or few owners (Tier 1) where feasible (Appendix B, Maps 14-16). Targeted outreach to owners of critical partners has been a successful tool used by project partners such as the D&R Greenway Land Trust, the Conserve Wildlife Foundation, and the NJ Conservation Foundation. These groups have demonstrated that successful landowner outreach can often lead to successful land acquisition, especially give the availability of matching land acquisition funding through the State Green Acres Program and the State Farmland

Preservation Program, as well as county and municipal open space and farmland preservation funds. Tier 1 parcels represent the best opportunities to acquire and manage large tracts of grassland currently in private ownership for the extremely area sensitive targets like Upland Sandpiper and Short-eared Owl. Acquisition of fee title or easement will mostly be concentrated in the western portion of the project area (Amwell Valley) where public land is scarcer. Where fee acquisition is not an option, purchase of conservation easements will also be considered. For example, the 650± acre Higgins Tract in Hillsborough and East Amwell Townships is a key Tier 1 parcel in the Amwell Valley whose landowner has been working with Conservation Resources to manage the property for grassland birds. The main intent and purpose behind acquiring properties such as these should be to manage the entire parcels as grassland. However, the protection strategy cannot end with acquisition. If acquisition occurs without subsequent restoration and management as grassland, then the acquisition contributes nothing to the grassland goals of the RPWHP. This strategy addresses threats and obstacles numbers 1 and 3 from Section 3 by targeting the best remaining unprotected parcels for grassland bird species and placing them into public or private ownership by a conservation organization.

Initiation of Implementation - Parcel Prioritization

In order to prioritize areas within each focal area, parcel lots that intersected with any focal area were extracted and grouped by the owner's name. The Garden State Greenways dataset produced by NJCF and NJ DEP was used in this process. Parcels owned by a landowner with more than 60 hectares in total were highlighted as Tier 1 parcels. Because they represent Foundation Core Hectares and are owned by a single landowner, these are the sites that represent the greatest conservation opportunity. Because of their size, they can also serve as the focal grassland patch within the defined core area. A Tier 2 list was created from all landowners within designated focal areas with a minimum of 28 hectares.

Before actual completion of the Grasslands Conservation Plan, the Partnership convened to discuss the 10 focal areas and Tier 1 and 2 parcels. Tiered parcels included three levels of land preservation – public land, private preserved farmland, and unprotected private land. There is an immediate need to focus stewardship activity on all as very little grassland habitat exists anywhere in the focal area on private public land. In the long-term the partners will seek solutions for unprotected parcels – e.g. conservation easements, acquisition, etc. to ensure long-term preservation of these properties in concert with appropriate management.

During the meeting, representatives from the non-profit organizations identified parcels they are currently working on or are interested in working on within the focus areas or nearby areas within the RPWHP project area. The Tier 1 landowners identified in the project area were discussed to see if any of the organizations were currently working with them. They represent the top priority for outreach both for stewardship and acquisition. In each of the 10 focal areas, all other landowners with parcels exceeding 28 hectares were also discussed as Tier 2 priorities.

To track conservation progress and clarify roles, notes on which partner organization was working in which areas were kept on a spreadsheet. A map is also being compiled to contain this information. A clear demonstration of the need for additional activity in the area was evidenced by the lack of familiarity with many of the largest landowners among the conservation partners. The RPWHP should thus serve as a critical catalyst for action in this area and add another layer to the conservation efforts already taking place.

8 Evaluation Plan

With general absence of habitat throughout the RPWHP region, restoration will be the primary emphasis of implementation. Therefore, evaluation is essential both to validate the population and habitat goals, determine whether they are adequate, and answering lingering questions for which there are not currently clear answers. Monitoring and evaluation of the project was the final, but critical, *Element 5,* presented by Will et al. (2005). Successful implementation of the RPWHP Conservation Plan will be measured in several ways. The primary measure is obviously:

1. Achievement of the population and habitat goals. This would require active management of the acreage specified in the habitat goals and that this acreage support the number of breeding pairs specified in the population goals.

Other measures would also include:

2. Total acreage of private land preserved through easement or acquisition and put into grassland management.
3. Total amount of publicly-owned land restored to grassland.
4. Matching dollars attracted for the project.

Assessing the success of management regimes

In 2005, the Natural Resource Conservation Service, the U.S. Fish and Wildlife Service, New Jersey Audubon, and the NJ Division of Fish and Wildlife co-founded the New Jersey Habitat Incentive Team (NJHIT). The goals of NJHIT are to conduct proactive outreach to private landowners to inform them about opportunities for funding from Federal and State conservation programs to manage for wildlife on their land. The Team unites a unique coalition of sportsman and mainstream conservation organizations under the common theme of wildlife conservation on private land. Following development of an outreach strategy, members of the NJHIT came to a unanimous decision that monitoring of lands enrolled in these programs was essential for establishing whether the program was successfully meeting its goals. To address this issue, the New Jersey Audubon Society and Conserve Wildlife Foundation collaborated on a grant to the National Fish and Wildlife Foundation that funded a biologist to administer the outreach program and a second biologist to coordinate a Citizen Science-based monitoring program to evaluate the success of private landowner outreach programs for preserving, creating, and enhancing habitat for bird species.

The Citizen Science project developed a monitoring protocol that establishes a measure of success and allows evaluation of enrolled farmland for response by target grassland bird species. This is achieved through development of datasets and conducting analyses to assess the response of breeding birds to grassland habitat restoration and enhancement.

The monitoring plan follows the conceptual framework set up by Block et al. (2001) for monitoring the effects of restoration on wildlife. Block et al. advocated using measures of population dynamics for a set of indicator or umbrella species that can constitute a 'restoration assemblage' (Lambeck 1997). That group of species has already been defined in the population and habitat goals of this plan complete with target bird species listed in Table 6. Grassland bird populations provide a good metric for determining habitat changes because they are easily seen (or heard) and counted using standard methodology that even relatively inexperienced observers can be trained to use.

The monitoring was designed as 'quasi-experimental' rather than an observational study, to allow for stronger inferences regarding the effects of restoration on bird populations (Block et al. 2001). Monitoring follows a general Before-After-Control-Impact (BACI) design (Green 1979), modified by using multiple controls and replicated experimental (managed) sites. While the selection of core grassland areas to be managed is not randomized and thus cannot be controlled for confounding factors, the design does allow temporal to be distinguished from spatial variability. That is, if variation among controls in both space and time is less than the variation within the restored sites, then the change resulting from restoration is greater than expected by natural year-to-year variability and thus the result of the management regime.

Specifically, the evaluation of success for the overall project goals includes:

1. Standard survey of lands to determine baseline information on abundance and distribution of target species prior to enrollment in conservation programs.
2. Follow-up up surveys after completion of habitat creation or enhancement to determine if management was successful in providing improved grassland bird habitat.
3. Recommendations for adjusting the approach to better refine utilization of conservation programs to best benefit target species.

The initial year of the Grassland Citizen Science Project was undertaken in Spring 2005 with recruitment and mobilization of approximately 50 volunteers. Volunteers performed fixed radius point counts of birds on grasslands at 342 road-side points. This preliminary information allowed development of a baseline control data set. In 2006, the project was expanded to include new and 1-yr post management sites as well as some that are now 4-5 yrs post management. A subset of roadside sites used in 2005 was also resurveyed. New managed sites provide information prior to any management activity, while roadside-counts provide controls.

This plan proposes to expand the Citizen Science Program to cover all sites identified for management or acquisition by the Partnership. Involvement of Citizen Scientists enables

the collection of the required information without using further staff resources. Furthermore, this additional outreach aspect will provide an opportunity for lay people to be involved in and better understand land management issues, even when they do not directly affect their own properties.

9 Conclusion

The RPWHP Grassland Conservation Plan uses the most current methods, technology, and datasets to develop an ecologically-driven, landscape scale conservation plan for grassland birds in north central New Jersey. The Plan uses a peer-reviewed methodology to set numerical population and habitat goals for rare grassland birds in the Raritan portion of the New Jersey Piedmont Plains.

The Plan builds upon the strength of the New Jersey State Wildlife Action Plan, by expanding the Action Plan's goals and developing specific numerical population and habitat goals for grassland birds in a region historically documented as one of the better grassland landscapes in the state. The Plan uses remote sensing to very specifically identify parcels and owners of areas with the highest habitat potential.

Recommendations for implementation of the plan follow an innovative strategy. Rather than relying strictly on land acquisition as previous preservation efforts in New Jersey have, the implementation plan calls for equal distribution of implementation effort amongst three initiatives: *effective, economical conservation on private lands, effective stewardship of public land, and strategic acquisition of critical habitat parcels.* This three-tiered structure to implementation is the backbone of the overall plan, and represents an innovative approach to conservation that provides multiple tools and strategies to the partners for effecting conservation. This integrated approach defines and unifies the RPWHP; it provides a diverse array of niches that allows each partner to contribute to implementation according to their strengths.

Overall, the RPWHP Grassland Conservation Plan provides a model for developing rapid conservation assessments and plans that can progress quickly to implementation. Implementation of the plan was initiated even before the final draft of the plan was complete. This commitment to the overall goals will ultimately allow more rapid fulfillment of the project's goals in a State where time is especially critical for conservation.

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